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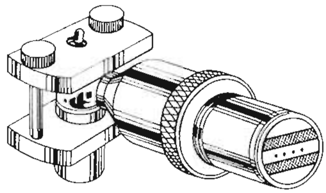

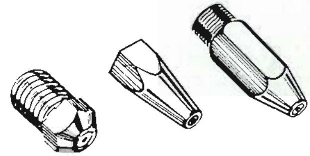

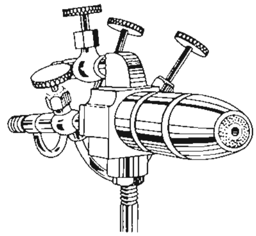

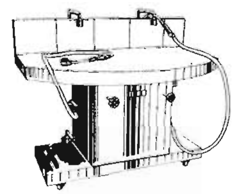

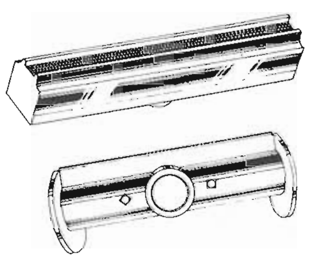

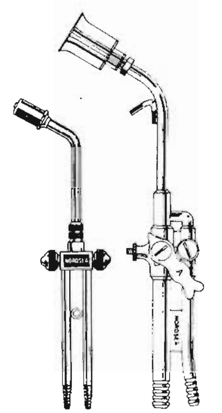

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INTERNATIONAL SYMPOSIUM 76

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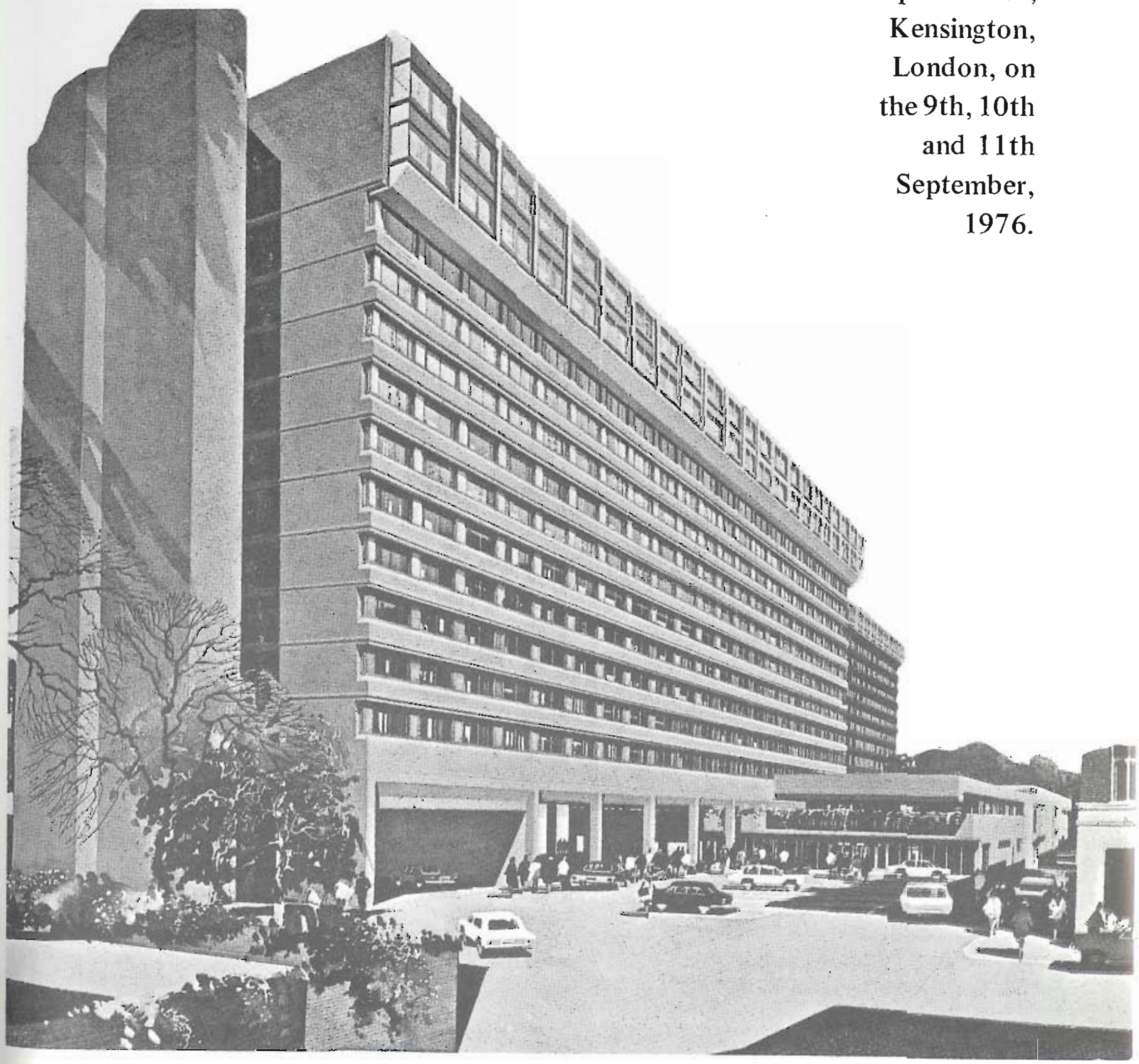
Kensington,
London, on
the 9th, 10th
and 11th
September,
1976.



GLASS TRANSFER SEALING TAPES

Kitty Ettre
Vitta Corporation, Wilton, Connecticut 06897, (U.S.A.)

INTRODUCTION

This paper describes the concept of the Transfer Tape process developed at Vitta Corporation. This technique provides a thin glass layer with extreme uniformity in both thickness and density and permits coating to be applied in both small and large scale applications. The application of the Transfer Tapes is illustrated by the sealing of quartz and Pyrex parts.

THE GLASS TRANSFER TAPE

The concept of the Transfer Tape process can be explained with help of Fig. 1 showing the composition of these Tapes. As seen, the Transfer Tape consists of four layers: the carrier layer, the glass layer, an adhesive film and the protective paper.

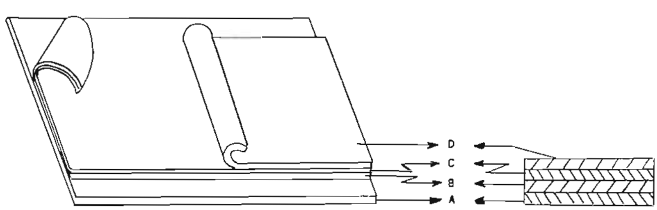


Figure 1.

General construction of a Glass Transfer Tape.
A – Carrier layer, B – Coating layer, C – Adhesive layer, D – Protective paper.

The carrier layer serves as a permanent support for the glass layer. It consists of a polyester (Mylar) or polyethylene foil, and it protects the glass layer from any outside effect. Since the tape is stored in rolls, the glass and adhesive layers are actually sealed between carrier layers during storage. Thus, by keeping these layers clean, long-time storage is possible.

The glass layer is composed of the glass powder mixed with suitable binders and plasticizers; this mixture is cast over the carrier layer. The green — unfired — thickness of this layer can generally vary between 10 and 1000 microns.

The adhesive film serves as a transfer agent in the transfer of the glass layer from the carrier to the substrate to be coated. The adhesive is composed of acrylic type polymers which decompose completely during the sealing process.

Finally, the protective paper has a release-coated surface in contact with the adhesive layer. Its only purpose is to protect this adhesive layer until application can be lifted easily from the adhesive layer whether by hand, as shown in Fig. 2, or — as will be discussed later — in automated machines.

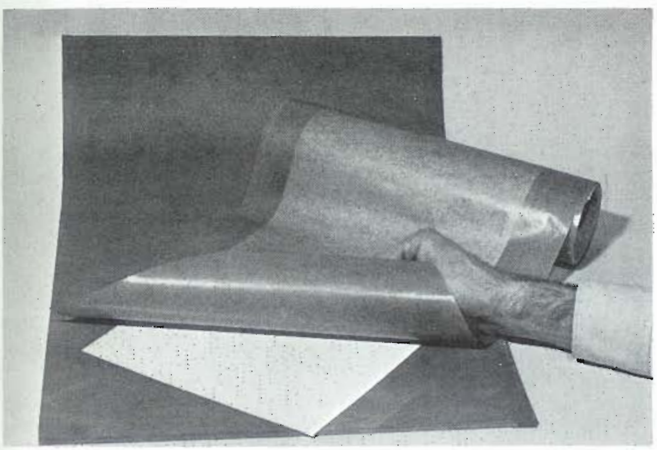


Figure 2.

Lifting the protective paper from the adhesive layer.

APPLICATIONS OF THE TRANSFER TAPE PROCESS

Trouble-free application of the Glass Transfer Tapes depends mainly on the proper adjustment of the properties of the glass layer. Below, a few considerations are given. Subsequently, questions related to sealing quartz-to-quartz and Pyrex-to-Pyrex parts are discussed separately.

Adjustment of the Glass Layer's Properties

In the Tape, the glass layer is bonded to the carrier layer by physical forces, depending mainly on the polarity of the carrier layer and of the organic binders in the glass layer. We can vary in a wide range the separation characteristics of the two layers by changing the characteristics of the organic binder and of the carrier. The separation characteristics also depend on the thickness of the glass layer: in general, thicker glass layers separate — "release" — more readily.

In cases where a part has to be coated exactly on a certain surface, the separability of the glass layer is adjusted properly so that it will only detach at the pressed areas. Thus after pressing the pieces on the layer simply by hand or a small tool, they can be lifted with help of a tweezer, or removed by rolling the Tape over a curved base. This latter operation is shown in Fig. 3. This figure demonstrates how well the pieces released the glass layer from the carrier.

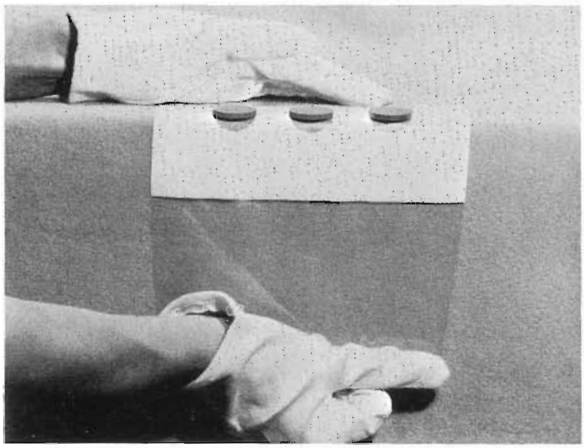


Figure 3.

Separation of coated pieces from the Transfer Tape.

The thickness and density of the glass layer can be controlled to $\pm$ 5% which is the most important factor permitting to obtain smooth, pinhole-free glazed layers. Fig. 4 is an example showing the difference. The top figure — "A" — shows a perfect, pinhole-free glazed surface, while the lower figure — "B" — shows some characteristic pinholes and roughness of the glaze.

Even if small pinholes may occur due to improper application or firing, they can be flown together by simply using a flame torch. The pinholes are so minute that the glass layer will seal again.

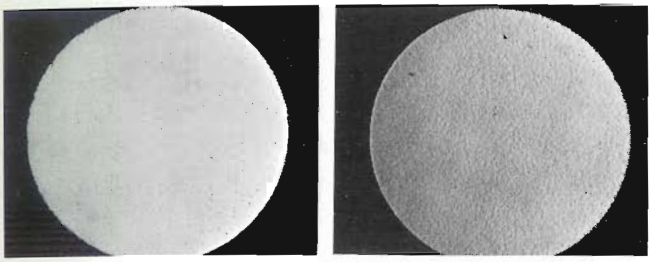


Figure 4.

A B

Glazed layers.
A – perfect, pinhole-free glazed surface, B – glaze with some pinholes and roughness.

Sealing of Quartz-to-Quartz Parts

It is well known that sealing quartz to quartz by the method of fusing directly the parts to be sealed is quite a hard job, and requires excellent workmanship if any reproducibility is desired. Even the most superb glassblower occasionally meets configurations where direct sealing is almost impossible. On the other hand, when Glass Transfer Tape is used to fire various quartz parts together, any geometry is possible, and the sealing process is relatively simple.

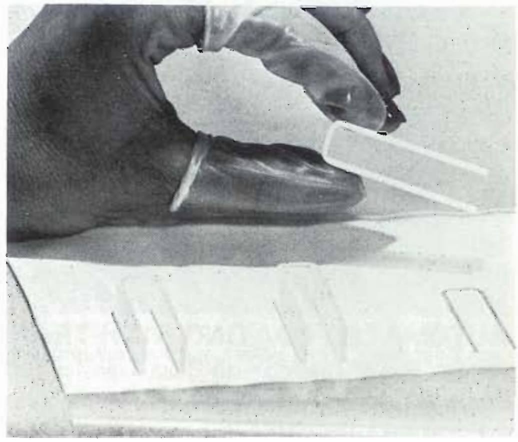
For sealing surfaces where both parts are excellently matched, a one-mil unfired glass layer was found to be the most satisfactory. The glass material incorporated in such a Tape is pure borosilicate glass with a thermal expansion value of around 32×10^{-7} in./in./^{o}C. Fig. 5 shows the coating of an U-shaped part most commonly used for cells in ultraviolet spectrophotometers. As can be seen, the part is coated exactly on the desired area and the empty U-shaped area can be seen well in the Tape, showing the area where the glass layer was released.

In case of surfaces which are not perfectly matched, we have found that raising the thickness from one to two mil (or selecting values between these two thicknesses, depending on the surface) produces a crack-free, vacuum-tight seal.

If a thickness higher than two mils is required due to the lack of surface match, we adjust the glass composition with help of additives. These added glass substances help to bring the thermal expansion closer to the thermal expansion of quartz. In this way, we can go as high as five mils without obtaining any crack due to thermal mismatch.

Fig. 6 shows various sealed quartz parts which were joined by using Glass Transfer Tape. Fusing was carried out by using the following sealing cycle: sealing started at room temperature, then the temperature was raised in about 60 to 90 minutes to the peak temperature of 900°C. The temperature was kept at this maximum for about one hour and then cooled slowly. We used a weight of about 10 – 12 ounces on the parts during sealing. The recommended surface finish for the quartz parts is alundum oxide 750–1200–1600 grit size; the last, 1600 grit size was found to be the optimum. No high polish is necessary.

Figure 5.



Coating of U-shaped quartz parts with Glass Transfer Tape.

This sealing cycle was found by us the optimum for this particular part shown on the slide; other geometries may require somewhat different sealing cycles. In most cases, we were able to shorten the time cycle, without affecting the seal.

Sealing of Pyrex-to-Pyrex Parts

Another interesting application for the Glass Tapes is to seal Pyrex to Pyrex parts. Obviously, the advantages are the same as already mentioned for quartz parts. However, here we had an even more difficult problem to overcome: to find a glass material (or a suitable mixture) which can be fired at a low enough temperature to prevent distorting of the Pyrex and at the same time, has a reasonable good thermal expansion match. Since the annealing point of Pyrex is around 525°C and its thermal expansion varies between 32×10^{-7} and 36×10^{-7} in./in./°C, our problem was obviously severe, since almost all glass frits melting below 450°C have a high thermal expansion value.

After a number of experiments – and these are partly still continued – we found a combination which when incorporated in a Glass Transfer Tape gives satisfactory results when used for sealing Pyrex to Pyrex. According to our results, the optimum thickness is two mil and we can go up to five mil without any problem. This is possible because the thermal expansion value of this glass layer is 45×10^{-7} in./in./°C which is much closer matched to Pyrex than the Glass Tape used for quartz sealing was matched to quartz. Actually, we believe that we could go higher in the thermal expansion value without any problem in the Pyrex-to-Pyrex sealing and this obviously would have the advantage to get a better "flow" of glass in cases when this is required. We have under evaluation several compositions, some of which showing excellent results.

Shelf Life

The shelf life of the Glass Transfer Tapes needs special considerations particularly since a piece of quartz or Pyrex obviously has an infinite shelf life.

The major factor influencing the shelf life of a Transfer Tape is the adhesive film; the carrier layer, the glass layer and the protective paper have an almost infinite shelf life. The tacky adhesive film consists of special organic materials which are sensitive against any contamination, dust and – most importantly – moisture in the air. These contaminants form a barrier between the adhesive and the piece to be coated and, as a conclusion of this, the "tack" slowly diminishes. However, this problem can be eliminated by vacuum packaging the Glass Tape thus eliminating the possibility of contaminations.

AUTOMATED COATING WITH TRANSFER TAPES

Automation of coating with Glass Transfer Tapes is very economical and suitable for mechanization in laboratory, semiautomatic or automatic equipment. Both the laboratory semiautomatic or the large scale automatic machines operate basically on the same principles as the unit shown on Fig. 7. Its main parts are the two suitable chosen rubber rollers – in the slide one of them is not visible – which apply the closely controlled pressure on the pieces during the coating, and a release edge which helps to separate the pieces from the Tape after they have been pressed onto the Tape.

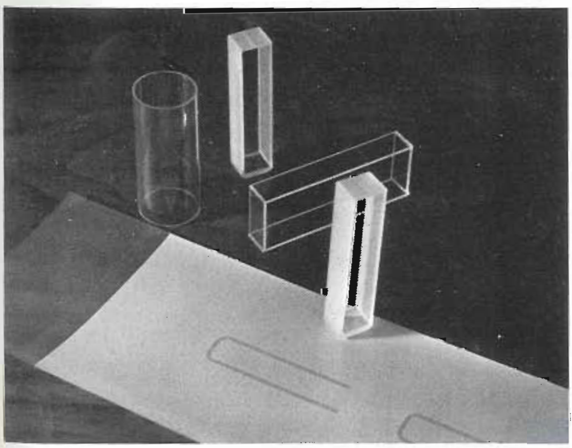
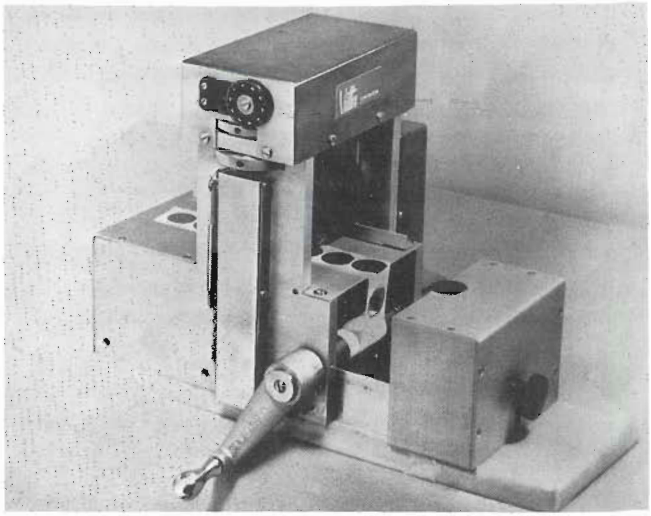


Figure 6.

Quartz parts which were joined using Glass Transfer Tape.

Figure 7.



Small-scale laboratory machine for coating various parts with Glass Transfer Tape.

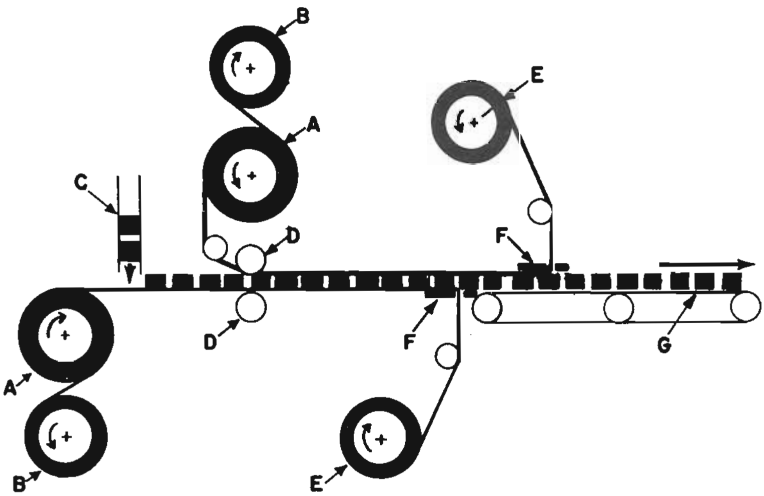


Figure 8.

Schematic of an automated machine for coating both sides of pieces.
A — Transfer Tape, B — release paper reroll, C — loading of the pieces to be coated on the Tape, D — adjustable rubber pressure roll, E — used Tape roll, F — release edge, G — conveyor belt to carry coated pieces to furnace.

The function of the machine can be described as follows:

A strip of the Glass Tape is laid on the intake side of the machine. Now, the pieces are loaded on the adhesive layer of the Tape. The pressure rollers are set by a dial indicator to the proper height depending on the pieces to be coated, this particular unit allows the coating of pieces up to a height of two inches. Next, the pieces are passed through the rollers using a pre-selected pressure and, in this way, the actual coating is performed *

Fig. 7 shows a small, hand-activated machine. Naturally, the pieces can also be driven through the pressure rollers with help of a motor.

In the applications shown in Fig. 7, silicone wafers are glazed with a 10-micron thick Glass Transfer Tape. The purpose of the coating is to protect the junctions from the environment.

A fully automated system, the schematic of which is shown in Fig. 8, is capable of coating high production quantities, up to hundreds of thousands of pieces daily. Such a system essentially consists of the same components as already discussed in connection with the laboratory coating machine.

The machine shown schematically in Fig. 8 was designed to simultaneously coat both sides of a piece. The pieces are fed on one Glass Transfer Tape at the loading zone. Then the second Tape is conducted to the other side of the pieces and they are pressed together with a previously adjusted pressure when passing through the pressure rolls. Finally, the coated pieces are separated from the Tapes by driving them through the release edge after which they are dropped on a conveyor and carried away to the firing furnace.

If only one-side coating is required, then the second Tape is simply disregarded.

The linear Tape speed of this operation can generally be varied between 0.3 and 5 feet per minute. Taking a middle value of 3 feet/min. the machine is capable of coating a very large number of pieces, the limiting factor being the feeding system.

SUMMARY

A new way for sealing quartz and Pyrex parts was introduced, by using the Glass Transfer Tape. The glass material is selected with the purpose of achieving a stress-free, vacuum-tight seal while, at the same time, considerably reducing the sealing temperatures. The application of the Glass Transfer Tape is very simple since the coating is achieved by the use of pressure only. The process lends itself for a variety of sealing applications: the paper specifically deals with sealing of quartz and Pyrex parts, but there are also many other applications of general interest.

Automation of the coating with Glass Transfer Tapes is economical and suitable for laboratory, semiautomatic or automatic equipment.

This paper was read at the 1975 Symposium by Mr. Rush — we are indebted to him and the author and Vitta Corporation for their co-operation.

ANNUAL COMPETITIONS

STUDENT MEMBERS

Student members may send in entries for the A.D. Wood Cup or Jobling Cup, according to experience, and also entries for the Thermal Trophy.

Don't leave the support of these competitions to the other students – you try and there will be a worthwhile entry.

At the Annual Symposium the A.D. WOOD CUP, JOBLING CUP and THERMAL TROPHY will be awarded to the student members for pieces of glass appartus considered by the Board of Examiners to be the most outstanding examples of craftsmanship.

In addition to the cups awarded for the best entries, B.S.S.G. CERTIFICATES OF MERIT will be awarded to all entrants whose work is considered to be of a high standard.

The judging will take place at a special meeting of the Board of Examiners to be held early in August. Please make certain your entry is in the hands of a member of the Board of Examiners by mid-July.

The apparatus submitted must bear a card giving the entrant's Membership number; Full Name; Full Address; Section and length of time of glass-blowing experience up to September, 1976. Please fasten this card to the apparatus, not the packing box.

A.D. WOOD CUP

To be held by the successful candidate for one year. Entrants for this award must be Student Members of the B.S.S.G. with glassblowing experience not exceeding three years. A small replica cup will be the winner's personal property.

JOBLING CUP

To be held by the successful candidate for one year. Entrants for this award must be Student Members of the B.S.S.G. with glassblowing experience not exceeding five years. A small replica cup will be the winner's personal property.

THERMAL SYNDICATE TROPHY

To be held by the successful candidate for one year. This Trophy will be awarded for the most outstanding piece of apparatus fabricated primarily in vitreous silica. Entrants for this award must be Student Members of the B.S.S.G. with less than five years experience as a scientific glassblower. A small replica cup will be the winner's personal property.

ALL MEMBERS

"The David Flack Memorial Trophy" – "To encourage members with artistic ability".

Members interested in submitting work for this Trophy, which will be presented at the Symposium, may obtain details from the Competition Secretary, Mr. R. Eustance, 42A Boroughbridge Road, Knaresborough, Yorks.

All submitted work for the above competitions will be on show at the Symposium. Every effort will be made to ensure the safe return of all entries. These will be available to entrants or their representatives at the close of the Symposium. The B.S.S.G. cannot accept any liability for loss or damage to entries.

Mr. Stafford-Scholes/Mrs.
Mr. John Glover & Mrs. U.S.A. Society

Mr. Jim,
Huckfield Symposium Committee Chairman

Mr. Don Curtis J.A.J. Cup
Mr. M. Holmes

Mr. Graham T.S.L., Presenting T.S.L. Award.
Winner — Mr. S. R. Short.

Presenting Award. 'FLACK' Mr. G. A. Flack.
to Mr. Andrew Thompson of J.A.J. Sunderland.

Alf Gardener, Thames Valley Award
to Fred Luadaka.

SYMPOSIUM 75

The 1975 Symposium of the B.S.S.G. was opened by Mr. R. Harvey, our Chairman. He welcomed the various overseas members and gave an appreciation of the late Mr. Stan Fussey. He gave a brief history of the B.S.S.G. and said how at this symposium all the lecturers would be introduced by founder members. The first lecturer Dr. R. Bastick was introduced by Mr. G. Isaacs and he talked about the manufacture of Precision Bore Tubing.

Dr. Bastick opened by saying that his company had made P.B. tube for hypodermic syringes, however they became obsolete when the introduction of the disposable syringes became the order of the day. However, with the shortage of plastics, the glass syringe was coming back again. He gave us a general résumé on the methods of drawing borosilicate tube and showed slides to demonstrate. The first was the pipe and ladder method, here a gob of glass was gathered on an iron, marvered and blown, attached to a punty and drawn onto a ladder, a third man would caliper the tube as the second man drew the tube along the ladder.

Another method invented in 1931 was the SHULER, or updraw, method. In 1930 the Wood process for thermometer tubes was used. In this instance a second pot of blue glass was incorporated to put the blue stripe along the tube. In 1929 the VELLO, or down drawn method, was devised. Here tube was drawn over a mandrel and dragged horizontally by a 'tractor' and cut to length as produced. Tube drawn by these various methods would be processed to make PB tube and there were various ways in which this could be done. Cooper devised a method in which the tube would be heated on a mandrel and evacuated to take up the form of the mandrel. In 1947 EVERETT used a method of expanding the tube by inserting a mandrel into hot glass. In 1949 FLOOD devised another method, he drew a mandrel through hot tube. MULLARD produced tube by collapsing the glass onto a mandrel and then stretching the mandrel to release the tube. Chance Bros. method was COOPERS patent. Here several mandrels were placed in a tube, then the glass was heated to 630 degrees centigrade and evacuated. The subsequent pieces of tube would then be cut up and the mandrels of stainless steel released. Tube was now made by them from 0.1mm to 44.5mm. Dr. Bastick

Dr. Bastick concluded his lecture with slides showing the effect of wear and tear on pistons and barrells.

The second lecture took the form of a film which was commentated by Messrs. ARNOLD and THOMAS of Messrs. RICHOUX Ltd. The speakers for the film were introduced by Mr. D. IVENS.

The demonstration of practical applications could not take place since the machine to be used which would have been in the country had not been available, so this film was shown instead. Over 21 operations were shown, some of which were punch card operated, they included cone and socket forming, ball and socket forming, necking of flasks, stopcock barrel making, joining on of stopcock sidearms, fire polishing, coil winding in quartz.

Also shown were machines for drilling and grinding, electron tube sealing, TV tube regenerating equipment and multiple tube calibrating machines. This was mechanization at its best, a really informative film and greatly appreciated by those present.

On the Thursday evening members and their wives were entertained by courtesy of Messrs. James A. Jobling in the form of a reception. The tables were amply stocked with a delightful assortment of foods and wines and the members were able to circulate freely and renew acquaintances. The BSSG thanks Messrs. Jobling for their kindness in providing such an excellent repast. Members also received an ashtray in 'Pyrex' ware bearing the motif of the BSSG 1976 Symposium, an excellent souvenir.

The first lecturer on Friday was Dr. P.W. McMillan, who was introduced by Mr. Bill Baker. He gave a most informative lecture on Glass Ceramics. The following abstract has been provided by Mr. Stafford Scholes.

[Dr. McMillan concentrated on those developments which have taken place in the applicability of glassceramics to engineering situations, with particular reference to work carried out at G.E.C. Power Engineering, Ltd., and by his team at Warwick. Two properties are of paramount importance: the static strength and the impact strength or toughness.

Normal glassceramics have static strengths in the range 20,000 – 60,000 p.s.i., which is several times the strength of glasses measured under similar conditions. Strengths can be enhanced in several ways. Often, the surface of a glassceramic article differs in its microtexture from the interior, and this gives rise to microstresses which can, in some cases, increase the strength. This situation can also be brought about artificially by the process of ion exchange. In sodium aluminosilicate glassceramics, for example, the article can be immersed in a bath of molten potassium salts, so that potassium ions enter the material and exchange for sodium ions. In this way, nepheline crystals in the surface layer are transformed into kalsilite, which has a lower density, thus creating a surface compression layer on the article, somewhat akin to thermal toughening, but of greater magnitude. Since the affected depth is also greater, this form of toughening is less sensitive to scratching than in the case of toughened glass. By this means, strengths of up to 200,000 p.s.i. can be obtained.

Ion exchange leading to a replacement of magnesium ions by lithium in a lithium-magnesium aluminosilicate glassceramic also gives rise to a compressive surface layer, but due to a rather different mechanism: in this case, crystals having a negative thermal expansion are formed in the surface, which expand on cooling down from the temperature of the molten salt bath. In the zinc aluminosilicate system, glasses can be strengthened by inducing surface crystallisation in the form of a layer 50–100 microns thick: by this means, fairly transparent articles with strengths of up to 120,000 p.s.i. can be obtained.

One approach to the problem of impact strength which has been explored at Warwick is to mix short, chopped, lengths of very thin nickel wire with powdered glass and to hot-press the mixture at $800^{o}-1000^{o}C$, during which the glass devitrifies. This does not lead to any improvement in the static strength of the material, but does result in dramatic increases in the impact strength, values approaching those of some metals being achieved with 30–40% nickel fibre incorporated.

Experiments have also been carried out to induce the growth of crystals with a high degree of common orientation in a glassceramic. The technique used has been hot extrusion of the glass, followed by heat treatment to devitrify immediately below the extrusion nozzle. The material crystallises to give needle-shaped crystals which lie parallel to the extrusion direction, and some rounder crystals of a second phase which also show some degree of orientation. Crack propagation across the orientation direction is more difficult, and the strength in this direction is about twice that measured along the direction of orientation, which is roughly equal to that of the normal non-oriented material.

The Corning machinable glassceramics were discussed which, as well as being machinable, have high impact strengths and high resistance to thermal shock. These qualities are due to the crack-stopping properties of the texture, which Corning refer to as a "house of cards" structure: the platy mica crystals are randomly oriented, so that cracks propagated along the cleavage plane of one crystal are stopped by the sheets of an abutting crystal. The residual glass is locked up in isolated inter-crystalline regions, instead of forming a continuous matrix as in ordinary glass-ceramics.

Dr. McMillan also discussed transparent glassceramics, most of which have very low thermal expansions, and are used for astronomical telescope mirrors, cookware, cooker tops, underwater lamps, and are made by the Japanese for use in oil heaters.

A number of applications for glassceramics were discussed in some detail, including solders for glass/ceramic, glass/metal, and ceramic/metal seals; new types of substrate materials for silicon chip devices; and artificial bone for prosthetics. In the latter case, experiments indicate that glassceramic implants containing calcium and phosphates in their composition "deceive" the bone into accepting the implant, so that healing between the bone and the implant takes place. This is particularly promising for long-life hip joint replacements which can be used for arthritic patients: such replacements are currently made only in elderly patients because the artificial joints now used have a limited life, and the operation is too severe to be repeated. Glassceramic-coated steel components are giving indications of very low wear, so that they can be considered for implanting in young patients].

The second lecturer on Friday was Mr. R. HARVEY our Chairman. He was introduced by Mr. LES (THE LEGS) HAYES.

Mr. Harvey opened by saying that he could not draw a straight line to save his life, so if he wanted a straight line then he would use a ruler. He then went on to present an excellent Paper which is to be published later in the B.S.S.G. Journal.

During the course of the lecture,entitled "Painting and Engraving on Glass", some very fine examples of his work were passed around including hand painted glass sheet, acid etched figures and figures produced by a reverse relief process, most ingenious, the background was filled in and the subject left as original glass. Some fine engraving work was shown to us and Mr. Harvey showed us how the flexible drive pen using dental grinding tools could be most effectively used, to produce figures on glass. One of his pictures of a nude lady was superbly presented. A really fine paper, provided by a real artist.

The first of the Friday afternoon lecturers was Mr. K. PIKE of the University of Sussex and he was introduced by Mr. BILL BAKER.

Mr. Pike opened by describing the various moulds he used, generally they were of stainless steel and double sided, different diameters on each side to conserve materials. Wells were cut into the faces to accommodate discs up to 40mm diam. and 2mm thick. Larger sizes could be up to 5mm thick. The moulds would be coated with a release agent which was french chalk mixed with water to a thin paste. The sintered glass was packed into the moulds and 'vibrated' to fill the mould, a straight edge would be drawn across the mould to ensure even thickness. The powder would be dried at 200 degrees centigrade first to ensure that all moisture was released, otherwise blow holes could be produced and render the finished plates useless. The sinters should be placed in a furnace and the firing usually took about 8 minutes, but the time factor varied according to conditions, time was based on experience and no hard and fast rule seemed to apply. Discs that needed to be domed would be made flat at first and then placed in a domed mould, reheated and allowed to sag. A good disc should be white and not grey, the surface harsh and not soft. The discs would contract on firing and so allowance for this should be made when making the moulds. Firing temperatures were roughly as follows:

Porosity 1 — 900 deg. C	Porosity 2 — 860 deg. C
Porosity 3 — 840 deg. C	Porosity 4 — 820 deg. C

The final lecturer on Friday was Mr. D. CURTIS of Messrs. James A. Jobling. He was introduced by Mr. L. HAYES.

Mr. Curtis opened by saying how much he appreciated the opportunity of addressing us. He gave a short history of Chemical Plant Manufacture starting from 1939 until the present day when the Q.V.F. standard was accepted and taken for granted all over the world. He asked that we should not use the name 'Pyrex' but borosilicate glass. He said that we should call ourselves Lamp workers *not* glassblowers. He had spent 25 years trying to eliminate 'blowing'. We were shown slides of some of the pipeline equipment made at Stone. Towers of 24" and 18" section and 100 metres high which were most impressive. A large heat exchanger would weigh 600 lbs when the coil was full of water. Mr. Curtis expounded on the merits of glass pipeline — visual application transmission of light, chemical and thermal shock resistance. Slides of circulating pumps and one of a 100 Ltr. rotary evaporater were shown. The development of the now famous buttress joint was given and we were shown slides of glass workers at Q.V.F. doing 24" joins. Mr. Curtis said that there were two books which he would recommend to members. One was "Glass Engineering" by Shand and the other, a paperback by Penguin entitled "New Science of Strong Materials". A most entertaining and informative lecture.

The Annual Dinner on Friday evening was a most memorable affair. The first part consisted of the meal itself. One often hears of the poor standard of food at university refectories but at Warwick University there could be little cause for complaint for the food and service were of a very high standard.

Unfortunately Mr. A. DYGERT was unable to be present. Our President Mr. STAFFORD SCHOLES kept us entertained and our visitor from America, Mr. GLOVER, was invited to speak about our counterpart in the USA, the American Society. Mr. Glover thanked us for making himself and his wife feel so 'at home' here and said how much he looked forward to coming to England next year with a contingent of about 90 Americans to attend our next Symposium. He presented Mr. R. HARVEY with the American Society's Pin and gave Mr. R. MASON his own personal pin in appreciation of his kindness.

The annual awards were next presented and the Thames Valley award went to Mr. FRED LUADEKA, Chairman of the Southern Section.

The Annual General Meeting went without a hitch, with virtually no controversial subjects. The reports were accepted without question, and the new subscription rates for 1976 are:— Full member £6, Associate member £6, Student member £3. The proposed new society rules were accepted verbatim.

The Officers elected en bloc were as follows:—

Chairman	Mr. R. HARVEY
Secretary	Mr. R. MASON
Treasurer	Mr. R. ADNITT

The first Saturday lecturer was Mr. P.G. HELLIWELL and was introduced by Mr. N. LOWDE.

Mr. Helliwell opened his lecture on "High Performance Chromotography" with a brief history of the past 75 years of Chromatography, by referring to the early days of plant material separation. He said the heart of Chromatography was the column. The techniques of Chromatography were not the main topic of Mr. Helliwell's talk, the essence being on design and testing of the apparatus itself. He said that it was now a standard practice to make columns of Precision bore tubes to ensure uniform flow rates of the various solvents. His company were now very safety conscious and tried to implement the new laws which put the onus of safety and quality on the manufacturer. Their columns were tested with utmost stringency and pressures up to 1,000 P.S.I. were applied in some instances. Strain viewers were used during the tests to note the points of strain. Tests were carried out to destruction. The branch of Chromatography discussed by Mr. Helliwell was, of course, Chromatography by liquid separation, gas chromatography being another field of application in which the company did not deal. This lecture, so well presented, was supplemented with slides showing the more simple columns, and the various formulae for calculating strain and strength.

The second Saturday lecturer, Mr. RUSH, was introduced by Mr. S.G. YORKE.

Mrs. ETTRE was unable to attend so Mr. Rush read her lecture for us at short notice.

The main topic was the Quartze to Quartze transfer tape. The components (there are four) comprise the following — 1) The Carrier layer, 2) The glass layer, 3) Adhesive film, 4) Protective paper. The glass layer is a combination of powdered glass binder and Plasticiser.

The adhesive layer is acrylic polymer, the glass layer is bonded by force to the carrier layer. The transfer tape is protected by a simple paper strip which is peeled off before use.

The transfer glass is a Borosilicate. The technique of application is a simple one, the sealing cycle for silica to Pyrex is ambient to 900 deg. C for 90 minutes under pressure.

The transfer material for Pyrex to Pyrex is of 42×10^{-7} coefficient of expansion.

The shelf life of the transfer tape is limited and governed by the adhesive which deteriorates. The tape comes in vacuum sealed packs and should be stored in a dessicator. Literature and tapes can be obtained from:—

Mr. R. Mason, Hon. Sec., B.S.S.G.

If the 1975 Symposium did not start with a bang, it certainly ended with one through the medium of the last lecturer Dr. R.B. CUNDALL, who was introduced by Mr. S.G. YORKE.

Dr. Cundall, in his lecture on "Principles and Nature of Explosives", gave us the definition of an explosion. Deflagration and detonation. In the first he gave the example of the phosphorous in the flask of oxygen, in the second he demonstrated the effect by igniting phosphorous coated crystal of potassium chlorate, the resultant explosion impressed the Monarch's head on an old penny into a piece of tinplate.

Next Dr. Cundall talked about firearms and how they worked, saying that from information recorded in the Christchurch library it was evident that the Arabs first made them in 1326.

Showing us with the aid of an old musket the way firearms were loaded, he proceeded to fire a candle through several thicknesses of wood.

Various demonstrations of rocket propulsion were given and, using an old pistol firing cotton plugs across the room, we were shown another application of explosive charges. Dr. Cundall then produced bottles of gaseous mixtures: 1) North Sea gas and oxygen, 2) Methane and oxygen, 3) Camping gas and oxygen, 4) Ethylene and oxygen. Each one in turn he detonated with startling effect, giving us all an indication of what could happen if we got our gas mixtures back down the line in our workshops. The most impressive one was the last, in which a mixture of Acetylene and oxygen was detonated, the bottle was reduced to powder with an almighty bang. Of course, all these experiments were done behind protective glass screens and Dr. Cundall had obviously perfected his technique to give maximum effect with maximum safety. We were shown the effect of flashback, using tubes containing Carbon disulphide, most impressive. Some of our members, I noticed, had quietly moved from the front row during this lecture.

Our final display was the ignition of cotton wool soaked in liquid oxygen, a most frightening effect with a very good safety story for those who thought enough about it — Dr. Cundall's two assistants, however, were very prompt with the fire extinguisher. Apart from a very good humoured patter from Dr. Cundall, much could be learned from this lecture and demonstration on safety and danger of not using non-return valves and of allowing gases to mix through the use of faulty or makeshift equipment. The 1975 B.S.S.G. Symposium certainly did not go out with a whimper.

The 1975 Symposium closed with an appreciation by Mr. Stafford Scholes, our President. He thanked all those who had worked so hard to provide us all with such an excellent series of lectures, and to the staff of the University for their first class services. He announced that £50 had been collected to the memory of Mr. Stan Fussey and, in accordance with the members wishes, this was to be sent to "The Organisation for the Relief of Cancer". Last of all he thanked the members of the B.S.S.G. for their support and wished us a successful next year's Symposium in London.

F.G.P.

EXHIBITORS AT THE 1975 SYMPOSIUM

A.D. Wood. London Ltd.

Service House,
1 Lansdown Road, London N17.

On display were a comprehensive range of their products, especially Cryogenics equipment. New products. "DIFFSTAK" pumping assemblies, of which they are stockists.

Midland Scientific Ltd.

Staffordshire.

A new young company, advertising with us for the first time. Specializing in general laboratory glassware. 'Quick' specials including silica ware.

HERAUS Quartz Fused Products,

Byfleet, Weybridge, Surrey.

Familiar high quality quartz ware on display, Spun quartz crucibles (snowballs) 1 metre 10 in. by 2 in. Rectangular tube (new product) B135 cone and socket. Now able to offer quartz cutting and grinding facilities.

Heathway Ltd.

Hillingdon, Middlesex.

Range of glassworking burners, including new "major" and "minor" bench lamp. Also on display 1¼" bore short bed lathe. A 4½" scroll chuck fitted to a shaft for use with a standard lathe chuck.

James A. Jobling Ltd.,

Sunderland.

General laboratory ware, multihead reaction unit with jacketed vessel. 'Rotoflo' taps. New product – High performance general chromatography equipment.

General Engineering Co.,

Vac. Products Division.

All metal vacuum components, gas welding equipment. Jeweller's torches. 'PORTAPAC' welding unit, 'HANDIGAS' propane torch.

R.C. Heard,

Shurdington, Glos.

Mr. "Robbie" Heard had on show some of his scientific glass ware as well as samples of his enamel and novelty glass ware. He gave demonstrations of glass animal making whilst the exhibition was in progress.

Messrs. RICHOUX Ltd.

Excellent selection of glassblowing burners. New product – 40mm Centrifuge lathe.

Thermal Syndicate Ltd.,
Wallsend on Tyne.

Exhibiting general Quartz laboratory ware, Buttress joints, larger bore clear Silica tube 15" I.D. Static prices now on Cone and Socket joints now in stock.

Chance Bros. Ltd.,
Smethwick.

Interchangeable hypodermic syringes, Precision bore tubing, hydrometer jars and some 'models in bottles' motor cars which were sealed in small bottles without damaging the paint, most intriguing.

"EDWARDS" High Vacuum Ltd.,
Crawley.

A familiar stand with us. Very impressive equipment and components including the new 'DIFFSTAC' system.

W.G. Flaig Ltd.,
Margate Road,
Broadstairs.

Displayed the range of stopcocks, joints from B5 – B55, also the flat all glass interchangeable stopcocks from 2 – 10mm bore.

Jencons Ltd.,
Hemel Hempstead.

In charge of this stand was the ever popular John 'Jacob' Beeson. Exhibiting their popular 'NATGAS' burner and glassblowers sundries. Also an interesting illuminating magnifier well worth investigating.

R.W. Jennings,
Nottingham.

Their range of 'LESCO' burners were on show, including the latest 8 jet burner. A splendid piece of engineering, beautifully made and giving a wide range of flames. Mr. J. Huckfield and his colleagues gave demonstrations of the new burner's capabilities.

R.W. Radley & Co. Ltd.

On the stand was Mr. 'Bill' Radley himself who exhibited some of their very fine glassware. They are now supplying disposable paper products and detergents. New lines were: glassblowers sundries, i.e. Stopcock plugs and barrels, condenser sidearms etc.

Mr. S. Daniels.

Demonstrating the art of coloured animal making, some splendid examples of this art were presented. An interesting device for pulling fibres of soft coloured glass were on show. The fibres were used to make very realistic birds' tails. Members of the Midland section also gave demonstrations of bench blown Scientific Glass ware.

EDUCATIONAL DISPLAYS

An educational stand was provided by the Warley College of Technology. Brochures of their courses were available and they illustrated their potential with a continuous slide show.

Also exhibited was a collection from BRIARLEY HILL GLASS MUSEUM.

The Dudley Glass Centre provided some excellent examples of glass craft and examples of students' work were exhibited.

A very interesting display of old glassblowing lamps and glassblowers' tools had been provided by Bristol University Chemistry Dept. and by Mr. Sid Hill of the Midlands section. An early flask holder was exhibited which gave members quite a laugh. An old foot bellows brought back memories for yours truly.

The ladies attending the Symposium and some of our overseas visitors paid a trip to the Stuart Crystal works, Stourbridge. A very enjoyable trip and a great opportunity to purchase some 'seconds' at a very modest price.

F.G.P.

PRESS RELEASE

Corning Glass Works of Corning, New York, USA, has named Edmund M. Olivier, a Corning vice president, as general manager of its Science Products Division. Mr. Olivier has extensive experience in the European chemical processing industries. Before joining Corning, he was with Continental Oil Company in Brussels.

Corning's Science Products Division produces and markets chemical process equipment, piping and laboratory glassware and equipment. In Europe, the Corning group has similar operations at James A. Jobling & Co. Ltd. in the United Kingdom, at Sovirel, S.A., in France, and at QVF Glastechnik G.m.b.H. in West Germany.

Within the division, Corning also named John J. Dunphy as manager of a newly created Commercial Development Department. This group is charged with increasing Corning's activity in supplying products and systems to the chemical processing industries.

Mr. Olivier joined Corning as director of Corporate Plans in 1972 and was elected a vice president in 1973. Before joining Corning, he was managing director of Continental Oil Company's Conoco Chemicals Europe, with headquarters in Brussels. Before that, he was European director of marketing for the Conoco Chemicals Division. Mr. Olivier had also been with Kaiser Aluminum and Chemical Company. He holds bachelor's degrees in liberal arts and chemical engineering from Rice University and a master's degree in business administration from the Harvard Business School.

Mr. Dunphy had been manager of market and product development in Corning's Scientific Glassware and Equipment Department since 1974. He joined the company in 1965 as a market planner in the Corporate Staffs Division and became controller of the Laboratory Products Department in 1969. In 1971, he was named vice president and manager of planning and control for Diagnostic Research, Inc., a Corning Glass Works subsidiary which has since been incorporated into the company's medical division. He returned to the labware group in 1972 as manager of market planning for Scientific Glassware and Equipment. Mr. Dunphy holds a bachelor of science degree from Massachusetts Maritime Academy and a master's degree in business administration from the Columbia Business School.

CHAIRMAN'S ANNUAL REPORT

We have just had a most successful Symposium at Warwick University and already the committee for next year's symposium has been formed and is under way. This committee will probably be one of the hardest working of any symposium committee we have had because our 1976 Annual Symposium will be International. International in name and as international in fact as we can make it. The site and date has occasioned some concern because of the necessity of linking our time and venue to suit the activities of our fraternal societies in other countries. We expect to host a large party of our American colleagues and already have a close liaison with the American Scientific Glassblower Society through their Midwest Director, John Glover. We hope that our friends abroad, particularly our German and Dutch colleagues, and others in Europe or Asia, whether members of a glassblowing society or not, will take this opportunity of joining us in making this symposium a truly International event.

Perhaps you are reading this Journal in Israel, or Japan, or Russia or nearer to home in France. Perhaps it is too far to come but you could send us a technical paper to be read at the symposium. We would welcome it, as indeed we hope to welcome you.

The applications for Master Glassblower now number 39 and the Board of Examiners will notify the successful applicants as soon as all the applications under Schedule 1 have been examined. The certificates for Master Glassblower will be presented at the Annual Symposiums, beginning with next year's International.

The Board/Examiners have also examined some 51 students at varying stages of competence from Elementary to Certificate of Competence and it is the intention of the Board to adhere more closely in future to the examination regulations with particular regard to the Certificate of Competence as this is held to be a qualifying standard for trained glassblowers.

My thanks to the Council and the Board for their usual dedicated hard stint and special thanks to Jim Huckfield's enthusiastic Symposium Committee who provided such an excellent symposium for us all. It never flagged, never lacked interest and saved its big guns for the last resounding lecture.

R.J.W. Harvey
Society Chairman

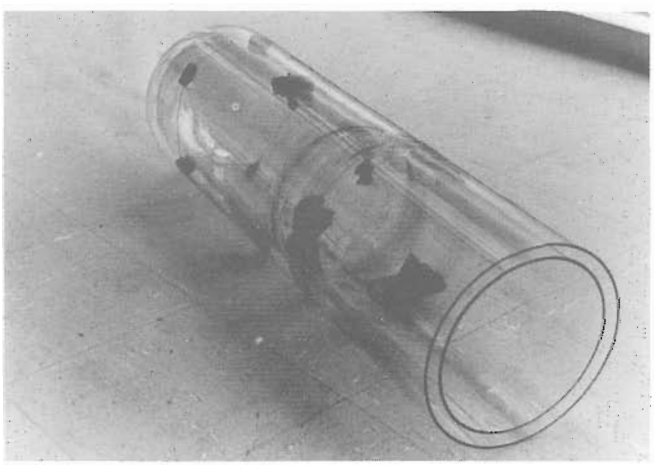
A BRASS BUTTERFLY FOR DEWAR ASSEMBLY

by F. Akerboom

An inexpensive mounting device can be made up from a woodscrew and some folded metal gauze, which will combine accurate location with firm holding properties in dewar assembly.

Mounting the inner shell of a dewar vessel prior to sealing is often something of a problem. Jigs may not be available if the size falls outside the standard range, or are just too expensive to be considered in the case of small runs or "one offs". In that case resort has to be taken to "packing", which is usually done with wads of brass or copper gauze. After the seal has been successfully made, these wads are burnt out with dilute nitric acid. Apart from locating the inner shell accurately, the wads have to hold the assembly firmly while rotating in the lathe. If the length of the dewar has to be made up by joining together a number of mould blown blanks, the two shells may not run truly parallel and packing can become exceedingly difficult. The idea of the butterfly fixing arrangement grew from the desire to jam the wad tight by some external means other than pushing it about with a long rod.

To construct the butterfly a 2½ in. strip of woven brass gauze of 10 mesh and 23 gauge was folded concertina-wise in strips slightly wider than the gap between the inner and the outer vessel required. A hole was pierced in the middle through the strip with an awl, the concertina extended to about 1¼ in. and a 1½ in. brass woodscrew inserted till a ¼ in. of the tip appeared on the other side. The thread of the screw should begin to bite in the gauze at about half way in. A few of the strands could be unravelled and wrapped round the protruding tip, if the thread did not catch the gauze sufficiently. The butterfly then needed to be flattened out a little and curved to fit snugly in the required space. Three of these gadgets were found to give sufficient grip, after having been tightened up in position with a long shanked screw driver, in the assembly of an 8 in. O.D. dewar vessel. The only other support was a collar of loosely fitting wads at the tail end, to stop the inner shell rocking.



NEWS

FROM

Western Section . . . "Flaig" evening

The Western Section were the guests of Messrs. Flaig Co., at the Dragonara Hotel, Bristol.

Mr. Zuber, in company with the Chairman, Mr. Houlden, and members of the section examining products of Messrs. Flaig Co. Ltd.

NEWS FROM JAPAN

The April session of the Japanese Society of Scientific Glassblowing was held on the 7th, at a science institute of Toshiba Electric Co., Ltd. About 50 members attended the session. Attractive ushers conducted the split groups to display of electronic devices with good explanation. The attendants were irresistibly attracted by them for two hours.

Hundreds of people visit the institute to learn the mechanism and application of electronics every week.

Mr. Natori of Toshiba Research and Development Center was chairman of the session.

Mr. Kusano Sakae was nominated as vice-president of the society to assist Coe Gotoh, as he has to work for some national commission in 1975.

Coe Gotoh

WESTERN SECTION REPORT

The October meeting of the Western section was held at the School of Chemistry Glasswork-shops, and it combined a business meeting with a short technical workshop session.

Decisions were made with regard to the Western Section Annual Dinner and also with regard to the running of an Annual Society Symposium here in the West Country.

The workshop session was a general talk on the setting up of the cylindrical grinder for the purpose of grinding either parallel cylindrical glass pieces or the grinding of tapers of various angles as used in many glassworking operations . . . the emphasis was on the setting up of the machine and the various ways of overcoming inherent difficulties in these operations . . . rather than the end product.

Another successful meeting again proving that workshop sessions are the popular type of meetings.

BOARD OF EXAMINERS

Overseas Training Programmes

One of the many aspects of the duties undertaken by the Board of Examiners is the formulation and implementation of training schedules on the subject of Scientific Glassblowing. A well established range of syllabi and examination procedures are available and are open to prospective students through the offices of the Board of Examiners in conjunction with Technical Colleges, Universities and Industry.

An area of increasing importance and anticipated demand is the call on the Board of Examiners to recommend, upon request, suitable tutors and examiners for short duration courses in locations external to the United Kingdom.

Such courses may be adapted to individual requirements, dependent upon local conditions such as student numbers and previous experience, equipment available, anticipated course duration, etc.

Interested parties requiring further information should contact the Hon. Sec., B.S.S.G. and, in the case of educational bodies, liaison with the Inter University Council, London may be beneficial.

BRITISH
SOCIETY
OF
SCIENTIFIC
GLASSBLOWERS